

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

2/15
20
52
U. S. DEPARTMENT OF AGRICULTURE
PRODUCTION AND MARKETING ADMINISTRATION,
MARKETING AND FACILITIES RESEARCH BRANCH,
WASHINGTON, D. C.

May 3, 1950

3

AN IMPROVED METHOD OF STACKING STANDARD DENSITY BALES
OF COTTON IN "CORDWOOD" ARRANGEMENT//1/

by

Alan W. Steinberg and Charles D. Bolt
Industrial Engineers, Marketing and Facilities Research Branch 2/

INTRODUCTION

The method of stacking described herein covers the stacking or tiering of standard density bales of cotton in "cordwood" arrangement. The term "method," as used herein, refers to the manner in which the crew performs the stacking operation and to the sequence in which bales are placed in the stack.

This method was developed by the authors in mid-1949, who made use, in part, of methods analysis of stacking operations observed in a number of cotton warehouses and compresses visited during the season. Tests with the improved method have been made in only one warehouse. In this warehouse the method was installed on a trial basis under the direction of the warehouse management and has since been adopted for use in that plant. 3/

General Description of the Operation

The warehouse operation consists of the actual tiering or stacking of standard density bales of cotton in what is usually known as a "cordwood" type of arrangement, by means of a high-lift fork-type industrial truck with boom attachment (known to most cotton warehousemen as a cotton storing machine or "boom stacker"). In the test operations conducted, the bales to be stacked were fed to the stacking crew by hand truckers and stacked on dunnage on earthen floors between paved aisles. For purposes of simplicity these features are not shown in any of the accompanying diagrams.

1/ The study on which this report is based is part of a larger research project covering materials handling in cotton warehouses. This is first of a series of reports to be issued prior to the completion of the project. The project is being financed with funds appropriated under the Research and Marketing Act of 1946.

2/ The authors wish to express their appreciation to Frederick C. Winter, assistant professor of industrial engineering, Columbia University, and industrial consultant to the Branch, for many valuable suggestions made in connection with the preparation of this report.

3/ The name and location of the warehouse may be obtained on request.

Although the stacking of bales five layers high will be covered in this report, the method may also be applied to stacking either four or six bales high. ^{4/}

Definitions

Terms used in describing the stacking operation are defined below. (See fig. 1 for illustrations of terms used.)

Column: A vertical, regular pile of bales, one bale wide, one bale deep, and two or more bales high.

Row: A series of bales, or columns of bales, arranged in a horizontal straight line.

Layer: A horizontal series of bales at a particular level within a row, or a separate bale of a column. Layers are numbered in the order of stacking or piling, from the bottom up.

Stack: An orderly arrangement of bales in a pile for purposes of storage.

OLD METHOD OF STACKING DESCRIBED

The order or sequence in which bales are stacked under the old or generally used method of stacking standard density bales of cotton in "cordwood" style is indicated in figure 2. The bale marked 1 is stacked first, bale 2 is stacked next, bale 3 next, etc.

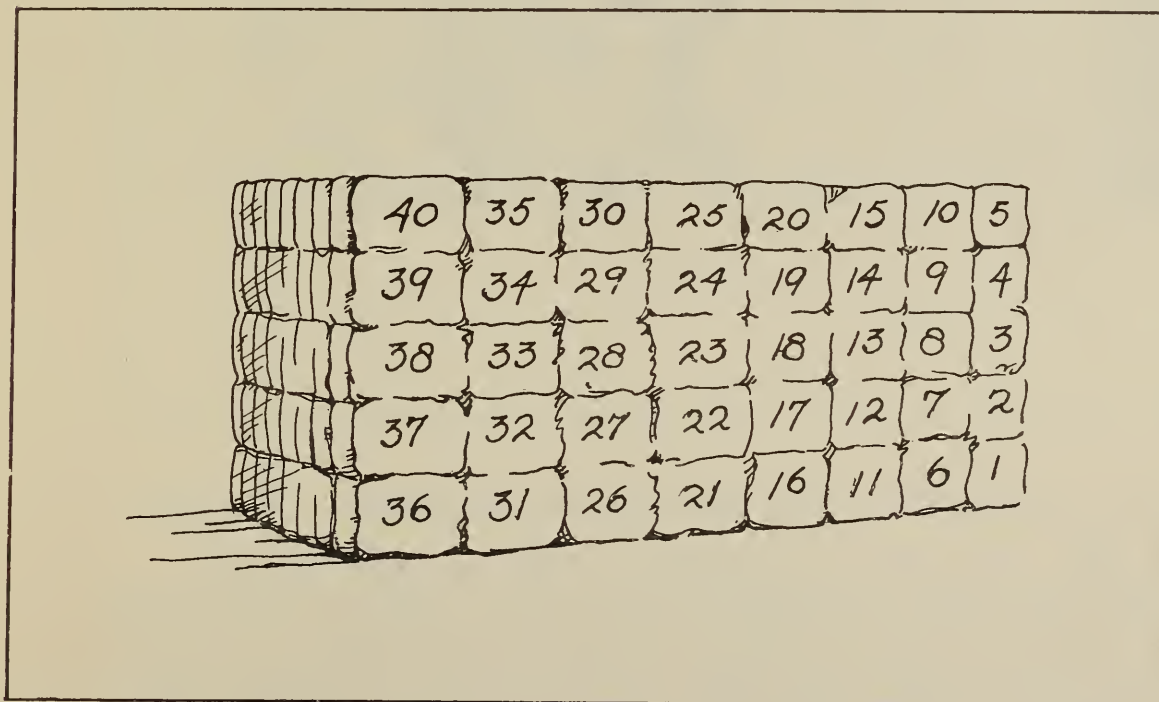


Figure 2.--Order of placing bales in stack when using old method.

^{4/} This report should not be interpreted as recommending the "cordwood" type of arrangement in preference to other types of stacks. The comparative efficiency of this and various other stacking arrangements will be covered in subsequent reports.

Stacking under the old method is performed by a crew of four men whose duties or functions are as follows (see fig. 3):

1. One man operates the boom stacker.
2. Two men work at floor level in the immediate area of the stacking machine. Their duties are to hook and unhook bales and manually push the bales which are suspended from the boom to or toward the positions the bales are to occupy in the stack, and to place in position in the stack those bales that will comprise the first three layers.
3. One man, stationed throughout the operation on top of the stack, assists in maneuvering into position only those bales which are to be placed in the fourth and fifth layers.

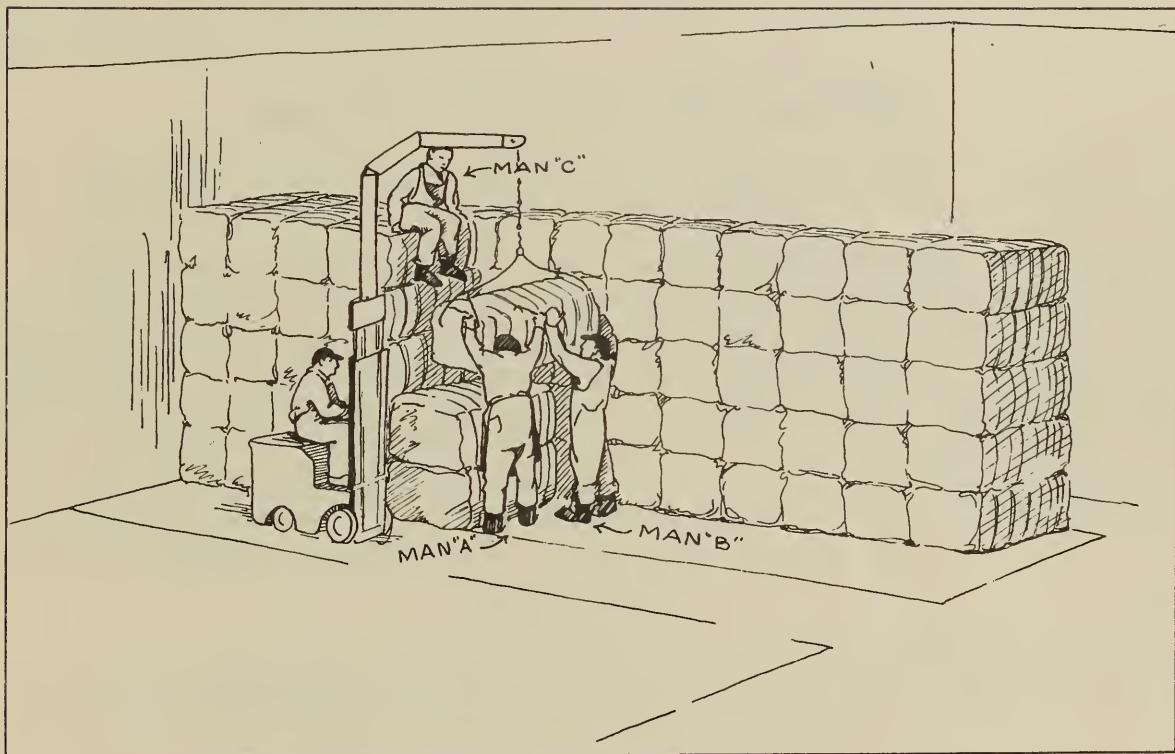


Figure 3.--Arrangement of crew when using old method of stacking.

The stacking is done as follows (see fig. 3): Men A and B (stationed at floor level near the machine) insert the hooks into the bale. The boom is raised, lifting the bale, and men A and B swing the boom by pushing the bale toward that part of the row in which the bale is to be placed. When the bale is to be placed in the first, second, or third layer of the stack, men A and B swing the boom until the bale is above the spot at which it is to be located, men A and B guide the bale as it is lowered by the truck operator and it is thus placed in position in the stack. Men A and B then remove the hooks and carry them to the next bale that

is to be stacked. This bale previously has been brought to the boom stacking machine by one of the hand truckers who are feeding bales to the stacking crew. When the bale is to be placed in the fourth or fifth layers, men A and B swing the boom until man C (stationed on top of the stack) can reach the bale with his hand hook. Man C then positions the bale above its intended location in the stack and the truck operator lowers the bale as man C guides it into place. Man C removes the hooks and lowers them to men A and B, who direct them to the next bale and insert the hooks as previously described.

It should be noted that when this method is employed, man C, atop the stack, is inactive for almost the entire period during which men A and B, who are on the floor, are working. For instance, man C is idle while any stacking is being done on any of the first three layers of a stack. In addition, men A and B are inactive for almost the entire period during which man C is positioning bales in the fourth and fifth layers. The only times when all three of these men are active are the brief periods during which the bale passes from men A and B to man C, and when the hooks pass back from man C to men A and B.

IMPROVED METHOD OF STACKING DESCRIBED

The crew required for the improved method contains three men or one man less than is used in the old method.

The stacking operation, under the improved method, is divided into two steps. The first step covers the placing or setting up of a row of bales three layers high extending from the wall of the compartment to the main aisle or to the opposite wall. (Stacking may, of course, begin at the aisle and extend toward the wall, but this will generally result in a loss of both space and speed.) The second step covers the placing of the fourth and fifth layers on top of the three-layer row previously built. The order in which bales are placed in the stack is shown in figure 4.

First Step

At the beginning of the operation the three men making up the crew are stationed as follows (see fig. 5):

1. One man operates the boom stacker.
2. Two men work at floor level and assist as before in maneuvering bales into position.

It should be noted that a man is not placed on top of the stack during this step or phase of the operation.

With the crew stationed in the above manner, the first three layers are stacked. The method of stacking each individual bale is the same as is employed in the old method, since in the old method man C, who is on top of the stack, is not involved in the stacking of bales in the bottom three layers.

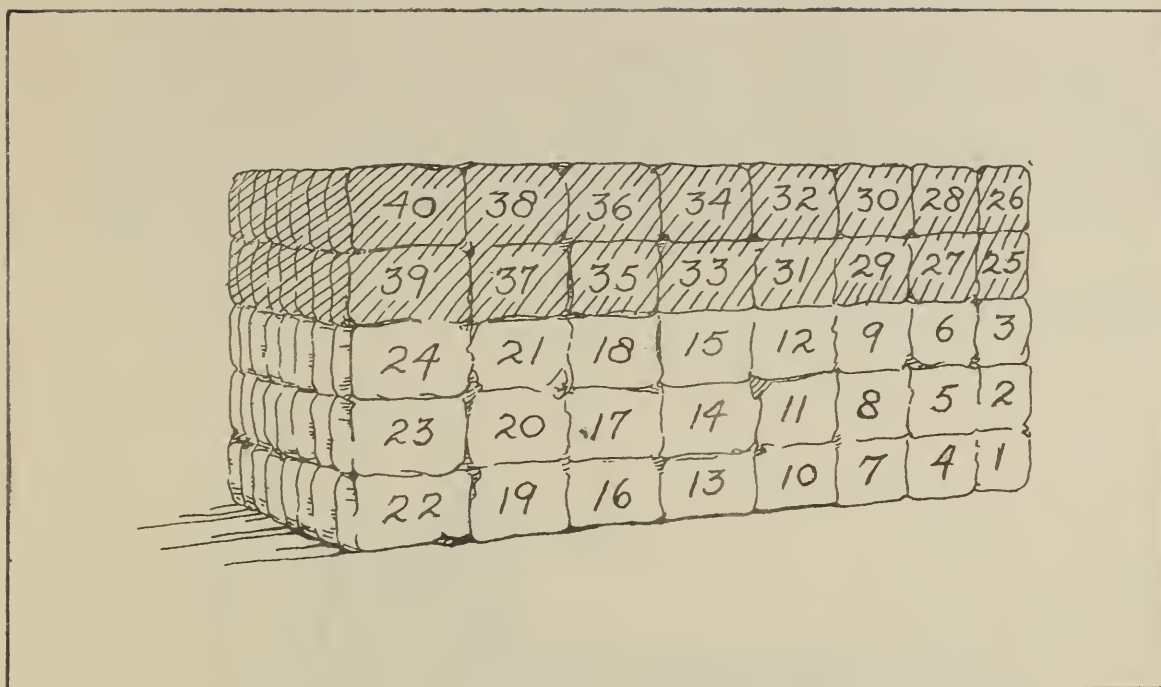


Figure 4.--Order of placing bales in stack when using improved method.

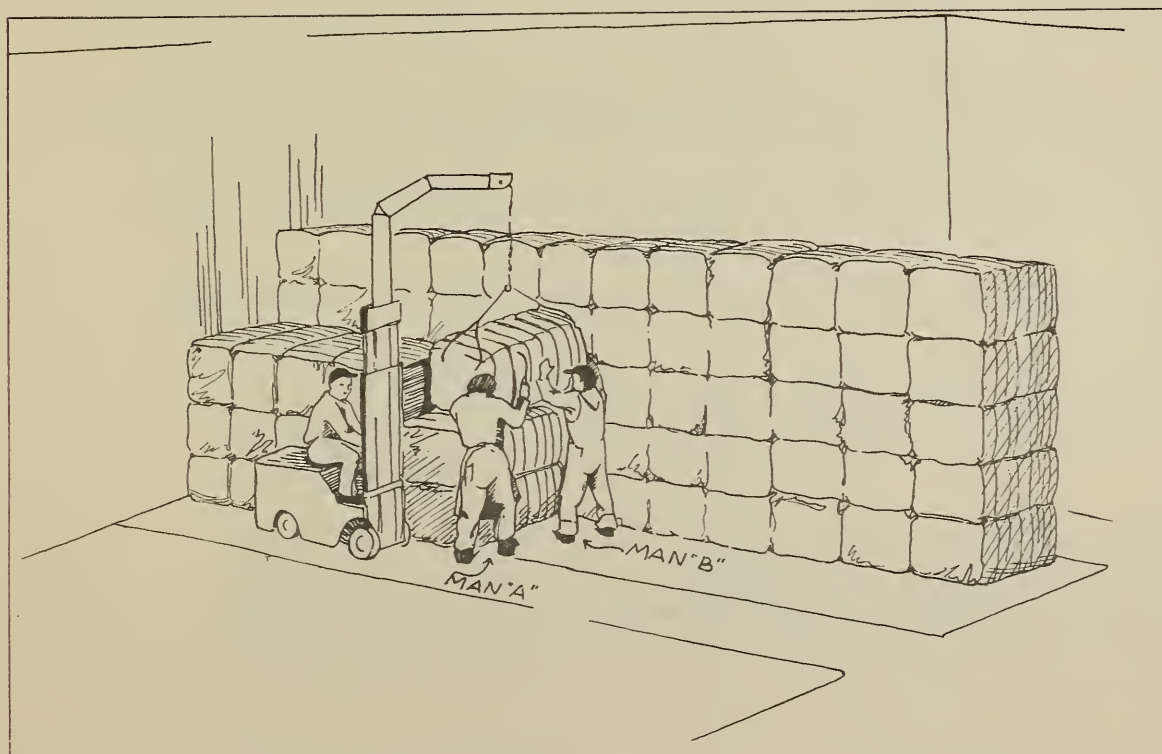


Figure 5.--Arrangement of crew during first step of improved method.

Second Step _

After the row has been stacked in this manner, "three high," to the main aisle (or to the opposite wall), man B climbs to the top of the stack and the stacking machine and crew (including man B) return to the beginning of the row, or to the point at which the first bale was placed in building the three-layer section. (See fig. 6 for position of crew at this time.)

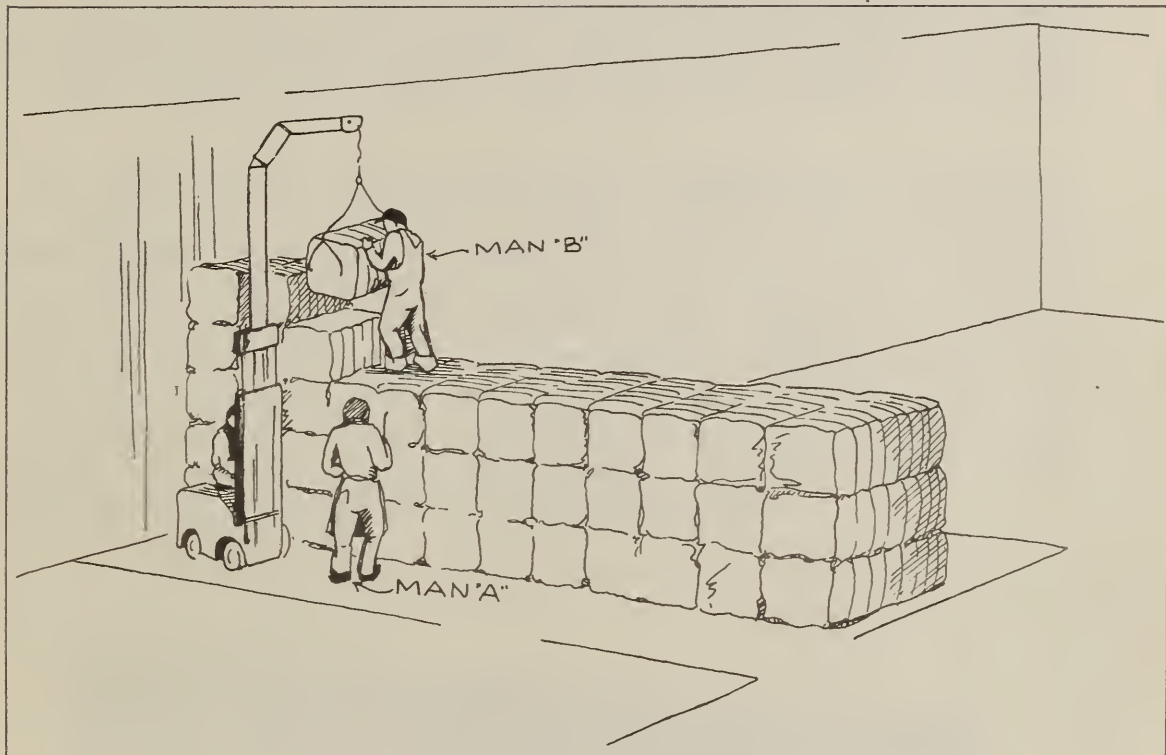


Figure 6.--Arrangement of crew during second step of improved method.

The fourth and fifth layers are now stacked as follows:

1. Man A inserts the hooks into the bale, the bale is raised by the boom stacker, and man A then rotates the boom by pushing the bale until man B (on top of the stack) can reach the bale with his hand hook.
2. Man B hooks and then positions the bale over its intended location in the stack, the bale is lowered into place, guided by B, and B removes the hooks and drops them to man A who brings them to the next bale to repeat the cycle.

Necessity for Avoiding Congestion in Feeder Aisles

When the feeder aisle is narrow and when rows of bales or previously stacked cotton line each side of the aisle, it may be difficult or impossible for hand truckers to pass each other without causing considerable delay or congestion.

In the plant studied, these delays were avoided by building a row or stack, half a row at a time. For example, in constructing a row of bales 120 feet long and 5 bales high, the procedure in the improved method is to first complete a 60-foot segment before another 60-foot segment is added, rather than to build a 3-layer row for the entire 120 feet and then place the fourth and fifth layers.

The steps involved in this procedure are indicated in figure 7. It was found that if each hand trucker who was en route to the stacking machine with a bale waited near the end of the three-high stack or row for the preceding trucker to pass him on the way out, the boom stacker would not be delayed and congestion would be avoided for, while the trucker is leaving the stacking machine and its crew is hoisting his bale and positioning it in the stack, the stacking machine is not ready to receive the next bale. This whole condition, of course, arises only during the second step of the improved method, and then only on alternate rows.

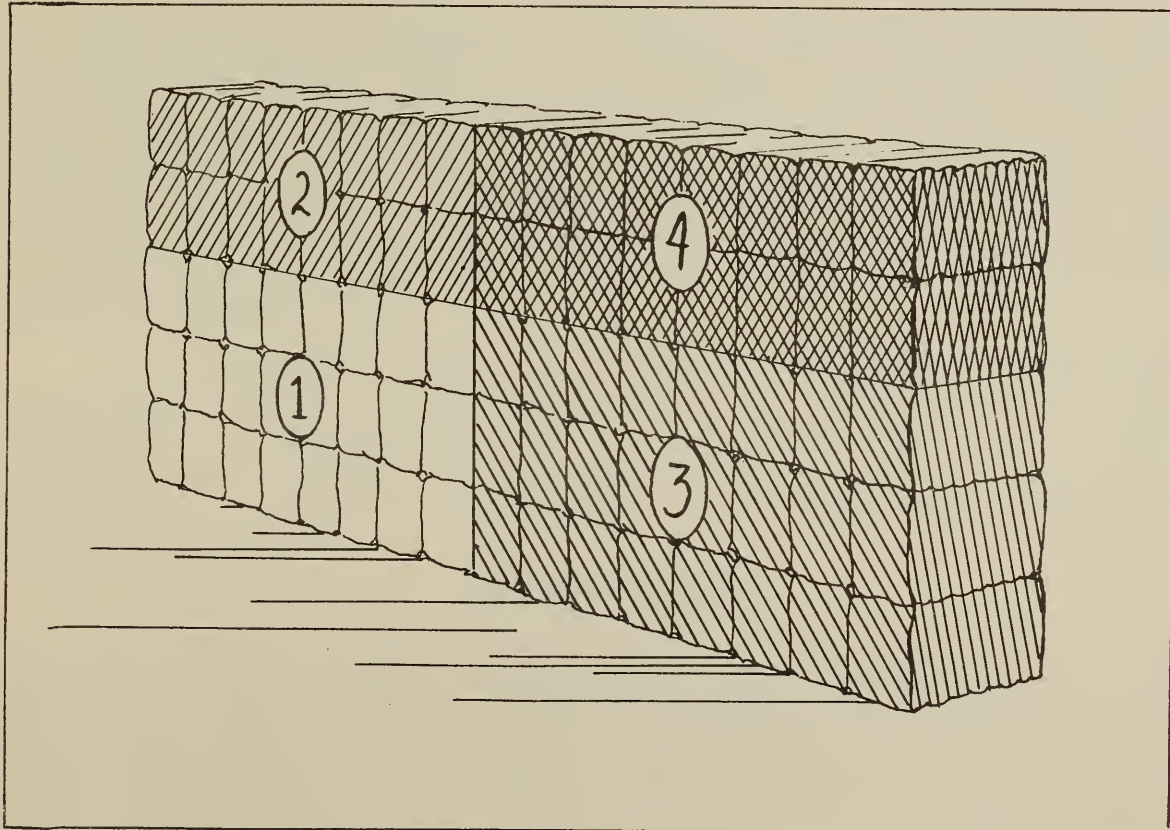


Figure 7.--Suggested order of building sections of stack to avoid congestion in feeder aisle.

COMPARING RESULTS OF THE TWO METHODS

The improved method obviously requires one less man than the old method. The important question then, is how does the productivity of the two methods compare?

Two types of evidence are available for making productivity comparisons between the two methods:

1. *Time study analysis* of observed operations in which each of the two methods was employed indicates that, assuming equal worker effort, a slightly higher stacking rate can be obtained with the improved method.
2. Based on *actual production results* the new method has proved capable of maintaining or exceeding any production rate obtained by the old method.

Both types of evidence indicate, therefore, that the improved method will stack cotton as fast as or faster than the old method. The two factors of equal or greater speed, and the reduction in crew size from four to three men would thus result in a saving in direct labor costs for stacking, on a per-bale basis, of at least 25 percent, assuming uniform wage rates for all crew members. 5/

DELIVERY OF BALES TO BOOM STACKING MACHINE BY TRACTOR-TRAILER TRAIN

The question may arise as to whether the improved method can be employed if the stacking crew receives bales directly from the trailer train rather than from hand trucks. Although no experiments have been conducted in which bales were delivered in this manner, there does not appear to be any reason to believe that the improved method is not applicable. *Whenever a man is used on top of the stack and at least two men are used at ground level, the improved method should make possible the elimination of one man from the stacking crew.*

If it should be found that man A has difficulty inserting hooks into a bale on a trailer without the assistance of man B, the use of a scissors-type hook is recommended (see fig. 8). This should make it possible for one man to insert the hooks without difficulty. However, this difficulty should not arise if man A is reasonably tall.

TRAINING THE CREW

Experience to date indicates that it would not take very long to train a crew to use the improved method. During the first day of its use at the plant at which this method was tried, the crew performing the operation attained production rates equal to those previously attained by the old method.

5/ Production and/or time study data supporting this conclusion will be presented in the final project report.

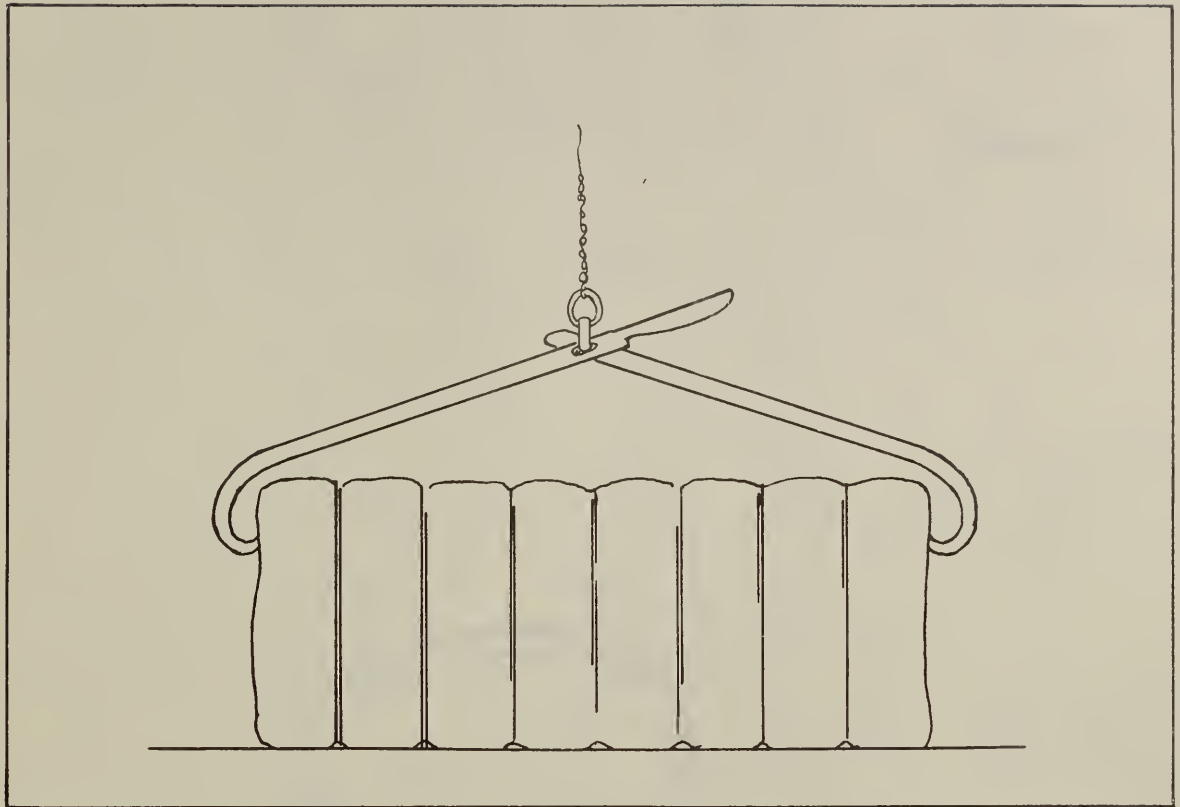


Figure 8.--Scissors type hook.

